Brown Dwarf Disks

Possible targets for TPF/DARWIN?

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Disks around young BDs

- Hints from near-infrared excess emission
  (e.g. Muench et al. 2001, Liu et al. 2003, Jayawardhana et al. 2003)

- Further hints for disks from ISOCAM archive
  (e.g. Persi et al. 2000, Comerón et al. 2000)

Can BD disks evolve into planetary disks?

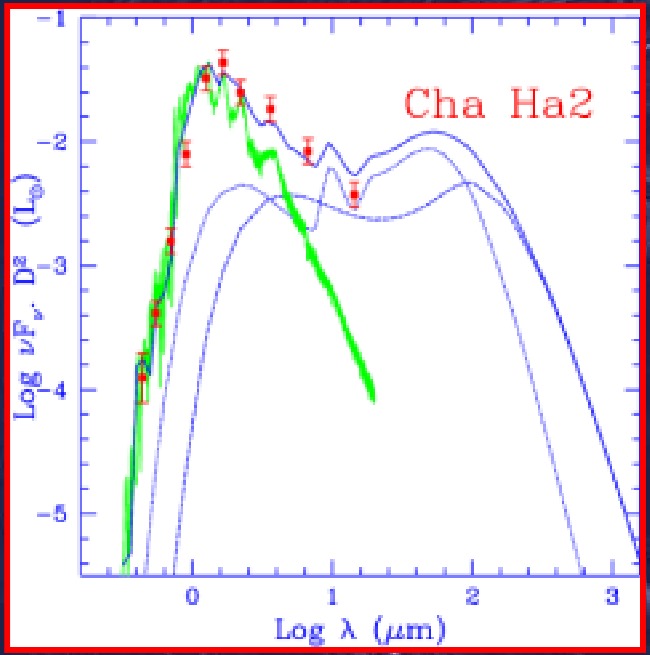
What is the structure of BD disks?

How do they compare to T Tauri disks?

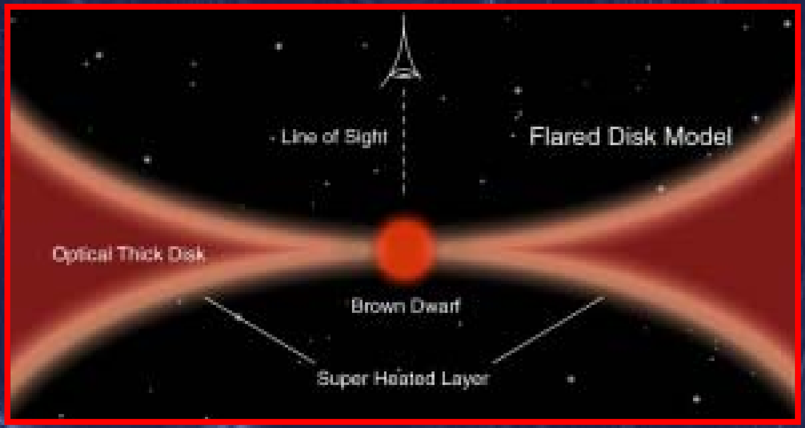
What are the dust composition and grain sizes?

Modeling the SED

❑ Scaled-down version of T Tauri disks → passive flaring disks (e.g. Chiang & Goldreich 1997)



(Natta & Testi 2001)

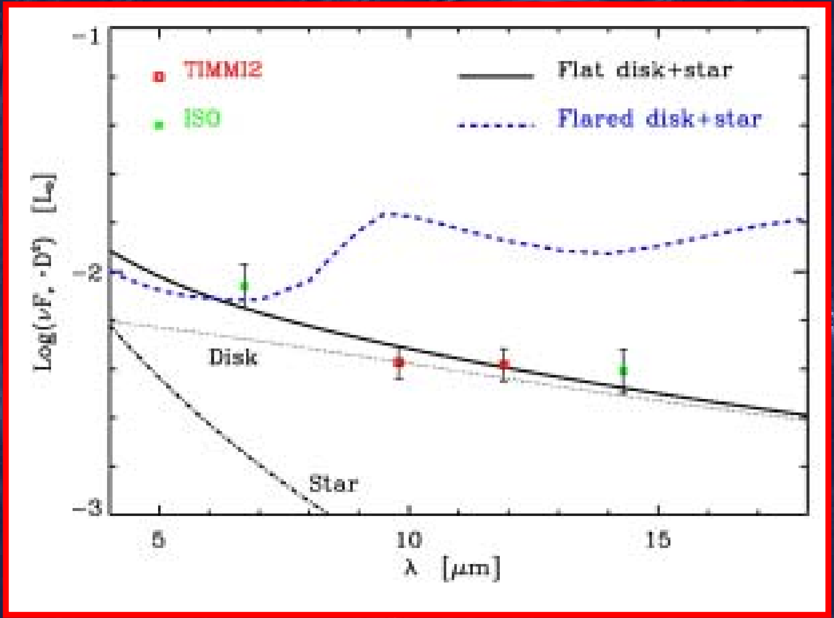


❑ Predictions: 1) large mid- and far-infrared excess
2) pronounced silicate emission feature

Disk geometry : flared vs flat

ESO/TIMMI2 observations to probe the silicate feature

Cha Hα2



(Apai, Pascucci, Henning et al. 2002)

- ❑ Absence of the predicted silicate emission feature
- ❑ Flat disk explains the observations

Disk masses

IRAM-30m @1.3mm

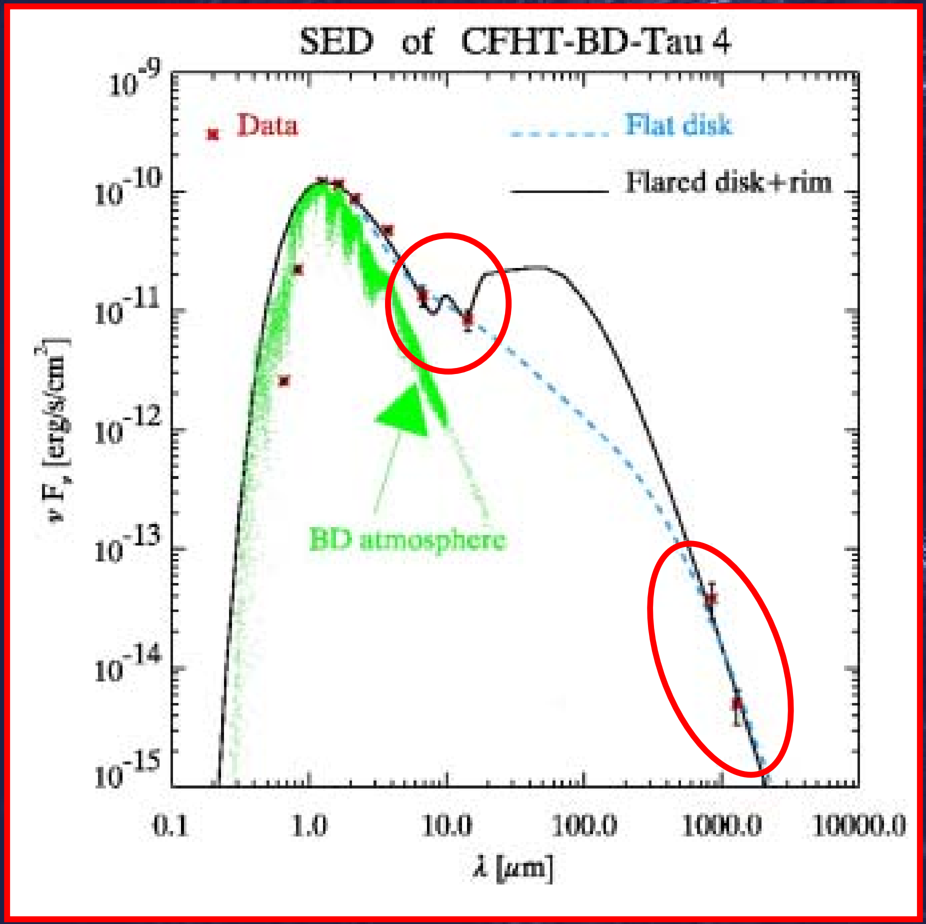
SCUBA @850μm

We targeted 9 young and
10 old/field BDs

- ❑ Detection of two young BD disks at 1.3mm and 850μm
  CFHT-BDTau4 and IC348-613
- ❑ Total disk masses of few percent of the BD masses (0.4-6 M_J)

(Klein, Apai, Pascucci et al. 2003)

A detailed look at the SED

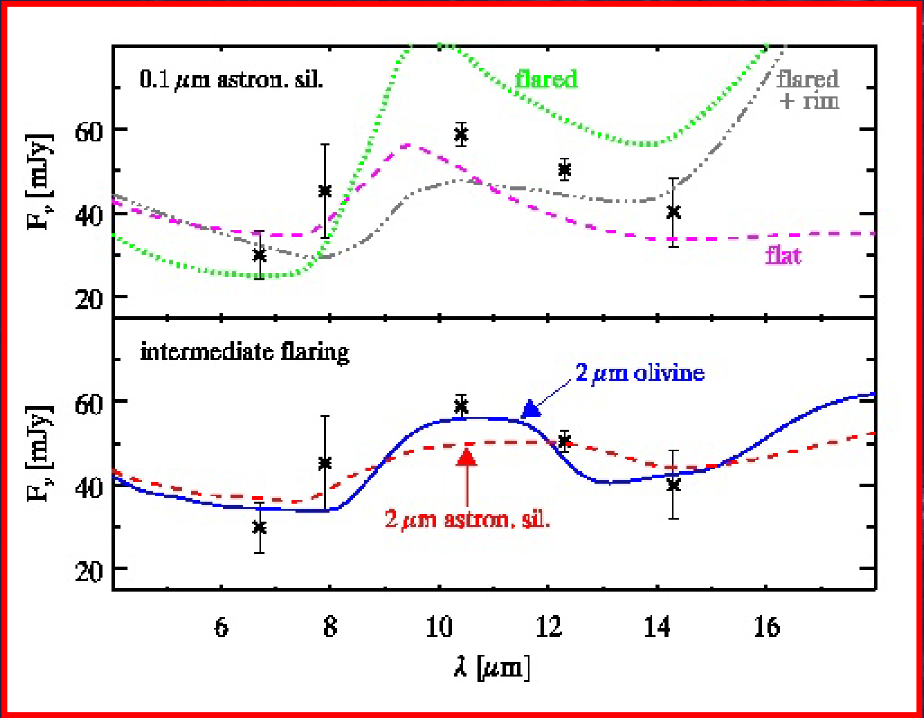


(Pascucci, Apai, Henning & Dullemond 2003)

- ❑ First evidence for a disk
- ❑ Classical flared disk does NOT reproduce the SED
- ❑ A flat disk fits well the observations. Hints toward large grain
- ❑ Flared disk with puffed-up inner rim explain the SED only if it has a large inner gap

Grain processing in a BD disk

TReCS/Gemini with 7.9, 10.4 and 12.3μm filters



(Apai, Pascucci, Sterzik et al. 2004, submitted)

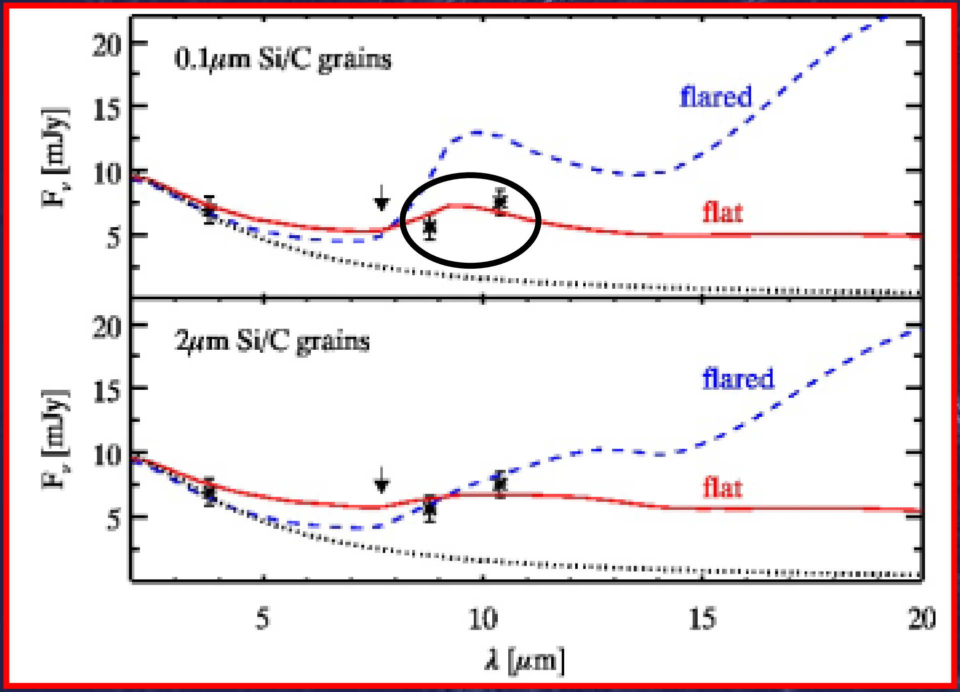
- Silicate emission feature → optically thin layer (see also Mohanty et al. 2004)
- The feature is dominated by 2μm amorphous grains
- A two-layer flared disk with reduced scale height

Grain growth and dust settling

Disk timescale

TReCS/Gemini: ~10Myr old BD in the TW Hya association

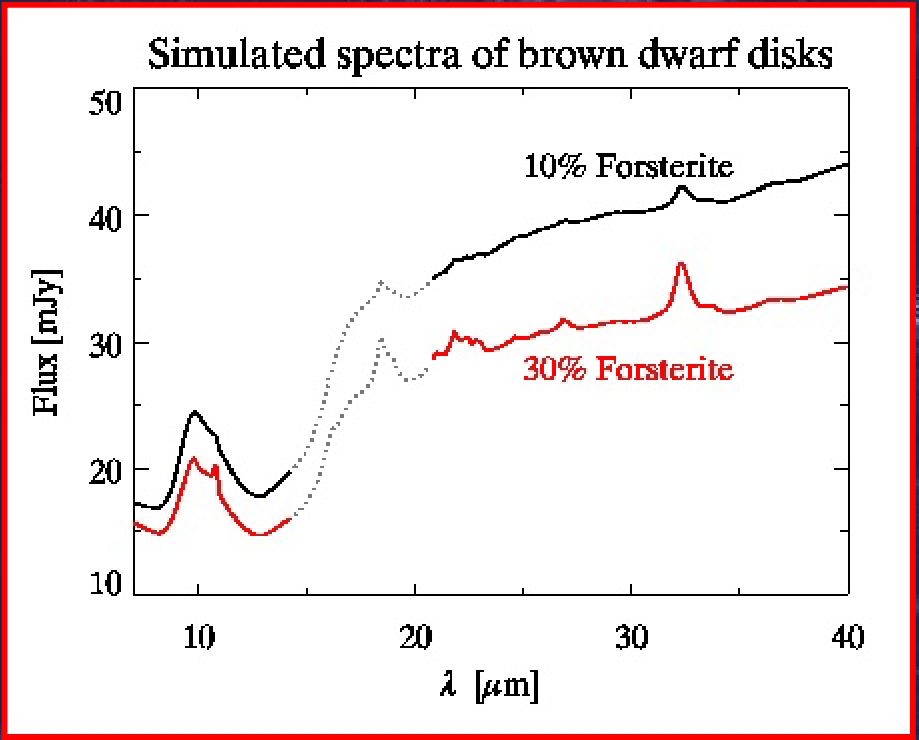
2MASS1207-3932



(Sterzik, Pascucci, Apai et al. 2004, submitted)

- ❑ MIR excess
- ❑ Hints for larger grains and flatter disk configuration
- ❑ **Timescale of BD disks similar to T Tauri disks**

IRS spectroscopy of 19 young BDs with known MIR excess using the SL1(8-13μm) and LL1(20-37μm) modules



Objectives

1. Structure of BD disks
2. Dust composition
3. Grain growth
4. Dust settling

- Young BDs frequently have disks
- Structure, evolution, lifetime similar to T Tauri disks

Closest terrestrial planet around a BD?

- „Neptun-like objects and terrestrial planets should be common around low-mass stars“ (M dwarfs, Laughlin et al. 2004)
- Number of nearby BDs ≈ number of nearby stars (e.g. Reid et al. 1999, 2004)

- MIR flux(Earth/BD)~1000 larger than flux(Earth/Sun). Detailed analysis required

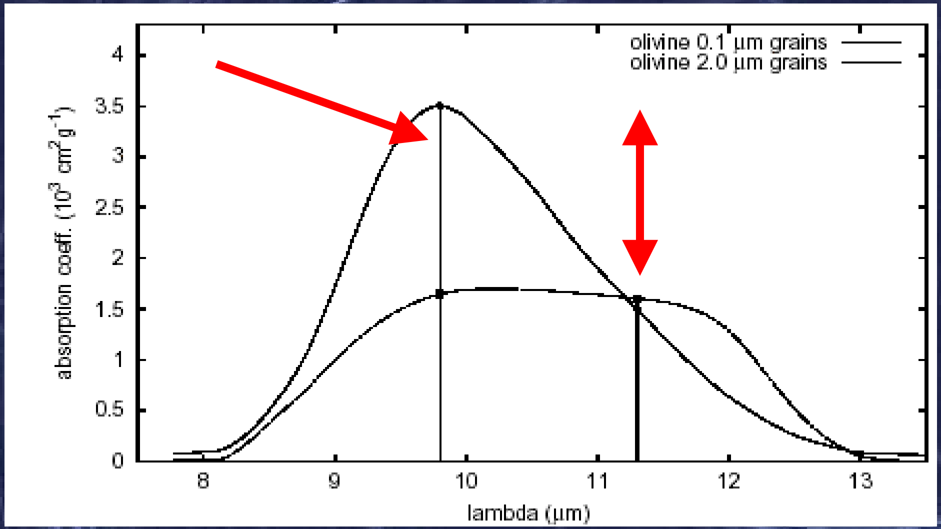
Brown Dwarfs

- Substellar objects less massive than the hydrogen- burning limit of ~80M_J but more massive than the fusion boundary of ~13M_J

Young BDs in star-forming regions, associations

Old BDs (>100 Myr) many close to us (<25 p

Grain growth



(Przygodda et al. 2003)

(see also Bouwman et al. 2003, Meus et al. 2003)